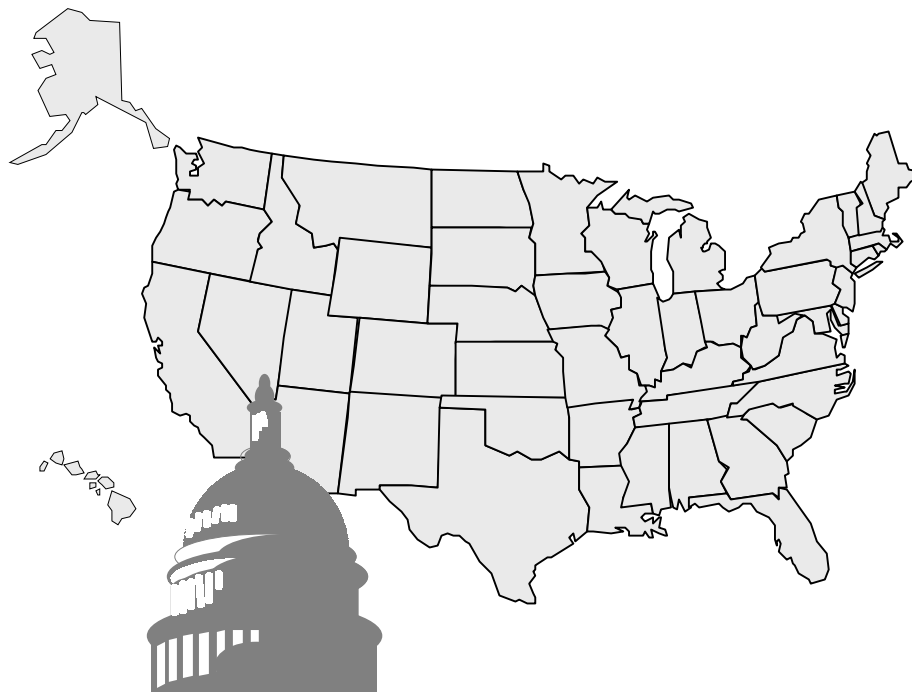


# WHAT IS THE STATE GOVERNMENT ROLE IN THE R&D ENTERPRISE?



Division of Science Resources Studies  
Directorate for Social, Behavioral, and Economic Sciences



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**National Science Foundation**

May 1999

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**National Science Foundation**

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# WHAT IS THE STATE GOVERNMENT ROLE IN THE R&D ENTERPRISE?

The pivotal role of state governments in expanding regional economic growth through science and technology (S&T) development is a widely recognized, albeit relatively recent, phenomenon. Practically all states have established lead S&T offices, most of whose existence can be traced back only to the mid-late 1980s.<sup>1</sup> During the 1990s, states increasingly have included an S&T component in their economic development plans, and between 1991 and 1995 no fewer than thirteen states adopted statewide S&T strategic plans of varying levels of sophistication and complexity (State Science & Technology Institute 1997). Further, a review of State speeches, inaugural addresses, and budget messages that were delivered by most governors in the early part of 1999 indicates a continuing high level of interest in S&T-based economic development (State Science & Technology Institute 1999). Overall, state efforts tend to focus on the creation of high technology firms and the use of advanced technologies in the traditional manufacturing and service sectors (Congressional Research Service 1998). Common to these plans is the acknowledged importance of:

- Maintaining and strengthening the research and development (R&D) capacity of the states' colleges and universities;
- Encouraging "home grown" businesses by providing support to entrepreneurs and small technology-based firms rather than seeking to recruit technology firms to locate within the state; and
- Facilitating the incorporation of new technology into processes and products.

States have become particularly adept at leveraging funds and fostering university-industry partnerships (State Science & Technology Institute 1997).

## HOW MUCH DO STATES SPEND ON R&D?

Based on a recently-released survey (1998) by the Battelle Memorial Institute and the State Science & Technology Institute (SSTI) of more than 1,000 state agencies and universities, states spent \$3.009 billion on R&D activities and

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<sup>1</sup>States frequently rename, reorganize, and restructure their administering bodies as a result of changes in legislative and executive leadership. Information on the earliest known S&T offices is available from the National Science Board (1991), appendix table 4-24. Only for North Carolina was an S&T-based state economic board, commission or agency identified for years prior to 1970.

supporting facilities in 1995.<sup>2</sup> R&D expenditures accounted for 92 percent (\$2.780 billion) of total funding and R&D plant for the remainder (\$0.228 billion). These totals include (i) expenditures for R&D performed by or in support of *state government agencies* regardless of sources of funds, and (ii) R&D funding provided by state governments to external parties, including most notably *direct R&D appropriations to academic institutions* through state budget processes.

State government sources (including general revenue funds, lottery proceeds, revenue bonds, and specially designated tax funds) accounted for most, 87.4 percent (\$2.431 billion), of total state spending on R&D activities in 1995 (table 1). Federal dollars passing through state agencies accounted for 9.3 percent (\$0.258 billion) of the state-directed R&D total, and leveraged funding from industry and other non-government sources for 3.3 percent (\$0.092 billion). Academic institutions performed 73.2 percent (\$2.036 billion) of all state government R&D spending reported in this survey. State agencies performed 14.7 percent (\$0.408 billion) of the R&D total, and the rest (\$0.336 billion) was split between industry, non-profit organizations, local governments, and individual performers.

**Table 1. State government R&D expenditures, by source and performer: FY 1995**

(Billions of dollars)				
Performers	Source of funds under state control			
	State	Federal	Non-govt.	Total
Total.....	2.431	0.258	0.092	2.780
State agencies.....	0.244	0.139	0.025	0.408
Academia.....	1.951	0.072	0.013	2.036
Industry.....	0.087	0.019	0.035	0.141
Other <sup>1</sup> .....	0.149	0.028	0.018	0.195

<sup>1</sup>Other performers include primarily non-profit organizations; this category also includes R&D funds provided to private individuals, local and county governments, and Federal agency performers.

**NOTES:** Because of rounding, detail may not add to totals. Excludes expenditures on R&D plant.

**SOURCES:** National Science Foundation/Division of Science Resources Studies, Battelle Memorial Institute and State Science and Technology Institute. Survey of State Research and Development Expenditures: Fiscal Year 1995. Columbus: September 1998.

<sup>2</sup>Most of the data on 1995 state R&D support presented here are derived from the report by the Battelle Memorial Institute and State Science & Technology Institute (1998). The survey was conducted under a grant from Division of Science Resources Studies/National Science Foundation (NSF). The data were collected to be comparable with other NSF R&D sector surveys.

Relatively few states accounted for a large share of total state R&D support in the Nation. Only five states—Texas, California, New York, Florida, and Pennsylvania—reported more than \$200 million in R&D and R&D plant expenditures (table 2). Combined, those five represented 44 percent of the total

**Table 2. States with the largest R&D and R&D plant expenditures, in absolute amounts, spending per capita, and as a share of total spending: FY 1995**

Millions of dollars		Dollars per capita		Share of total state spending (percent)	
All States.....	3,008.8	All States.....	11.48	All States.....	0.42
Texas.....	326.2	Kansas.....	32.73	Nebraska.....	1.14
California.....	274.0	Hawaii.....	29.83	Kansas.....	1.13
New York.....	267.1	Nebraska.....	28.45	Georgia.....	1.01
Florida.....	255.9	North Dakota.....	26.75	North Dakota.....	0.97
Pennsylvania.....	204.9	Georgia.....	25.31	South Dakota.....	0.94
Georgia.....	182.2	South Dakota.....	21.63	Texas.....	0.83
Ohio.....	114.2	Montana.....	21.00	Montana.....	0.78
Illinois.....	111.7	Florida.....	18.06	Arizona.....	0.73
North Carolina.....	104.8	Iowa.....	17.33	Florida.....	0.66
Kansas.....	84.0	Arizona.....	17.24	Pennsylvania.....	0.65

**SOURCES:** National Science Foundation/Division of Science Resources Studies. Battelle Memorial Institute and State Science and Technology Institute, Survey of State Research and Development Expenditures: Fiscal Year 1995. Columbus: September 1998.

reported for all 50 states. They were also the five most populous states in 1995. By comparison, for many smaller states in which state government R&D spending was considerably less, the levels nonetheless represented a substantial investment relative to the state's population size—led by Kansas and Hawaii. Also, although no state reported that R&D activities accounted for a large share of total state spending, those with the highest R&D-to-total spending ratios were relatively small states. Only Nebraska, Kansas and Georgia indicated that spending on R&D and supporting facilities accounted for more than one percent of state spending for all purposes. For all states combined, the reported level of R&D and R&D plant spending was equivalent to \$11.48 per capita and 0.42 percent of total state government expenditures (\$724.4 billion). By comparison, the Federal investment in R&D and R&D facilities reached \$70.9 billion in fiscal year (FY) 1995, an amount equivalent to 4.61 percent of the total Federal budget (\$1,539.7 billion).

## HISTORICAL SNAPSHOTS

Although the National Science Foundation has sponsored intermittent surveys of states' R&D expenditures dating back to the mid 1960s, their direct comparison with the recent Battelle/SSTI survey is somewhat complicated. Previous surveys tracked only the expenditures of funds that passed through state agencies

(including state agency funding of university R&D), but did not attempt to capture direct appropriations to the academic sector. Consequently, previous state surveys understated states' total R&D support by a considerable amount, although they accurately portrayed funding levels by and through state agencies.

A more appropriate historical comparison is obtained by subtracting state-reported R&D funding to universities from the state agency surveys (1965, 1977, 1987, and 1995 in table 3) and replacing it with university-reported state

<b>Table 3. Trends in state government R&amp;D expenditures</b>				
	1965	1977	1987	1995
<b>As originally surveyed</b>				
(Billions of dollars)				
Total state R&D spending <sup>1</sup> .....	0.088	0.359	0.908	2.780
State sources.....	0.050	0.198	0.690	2.431
Federal sources.....	0.036	0.142	0.201	0.257
Non-government sources <sup>2</sup> .....	0.002	0.019	0.017	0.092
<b>Adjusted to reflect university-reported performance</b>				
(Billions of dollars)				
Total state R&D spending <sup>1</sup> .....	0.221	0.689	1.739	2.511
State sources.....	0.183	0.528	1.521	2.161
Federal sources.....	0.036	0.142	0.201	0.257
Non-government sources <sup>2</sup> .....	0.002	0.019	0.017	0.092
<b>(Billions of constant 1992 dollars<sup>3</sup>)</b>				
Total state R&D spending <sup>1</sup> .....	0.884	1.451	2.093	2.336
State sources.....	0.732	1.112	1.830	2.010
Federal sources.....	0.144	0.299	0.242	0.240
Non-government sources <sup>2</sup> .....	0.008	0.040	0.020	0.086
<b>State R&amp;D indicators</b>				
State R&D/U.S. R&D.....	1.09%	1.58%	1.37%	1.37%
State sources/U.S. R&D.....	0.90%	1.21%	1.20%	1.18%
State R&D/U.S. GDP.....	0.031%	0.034%	0.037%	0.035%
State sources/U.S. GDP.....	0.025%	0.026%	0.032%	0.030%

<sup>1</sup>Includes all funds under state government control. These include state sources such as direct appropriations and funds generated from state bonds, funds from the Federal Government that pass through state agencies and leveraged funds from industry and other nongovernment sources.

<sup>2</sup>Non-government sources include industry and other non-state, non-federal sources such as donations, endowments, and gifts from private individuals or foundations.

<sup>3</sup>GDP implicit price deflators used to convert current dollars to constant dollars.

**NOTE:** Because of rounding, detail may not add to totals. Excludes expenditures on R&D plant.

**SOURCES:** National Science Foundation/Division of Science Resources Studies. Original survey data from NSF (1967), NSF (1979), NSF (1990), and Battelle/SSTI (1998). U.S. R&D and GDP data from NSF (1998a). Adjusted data derived by substituting state-funded academic R&D totals reported by states with comparable data reported by academic institutions (NSF 1998b). See references for full citation.



and local government R&D funding to higher education institutions.<sup>3</sup> The university-reported data on state sources of expenditures consistently include funds separately budgeted for R&D regardless of whether they were obtained from state agencies or direct appropriations from state legislatures. Such direct appropriations is the primary method of academic research funding in some states.<sup>4</sup> On the basis of these modified statistics, the recent growth in state R&D support is readily apparent, but generally has been proportionate to changes in other R&D indicators.

Between 1965 and 1995, total state R&D spending increased at an inflation-adjusted average annual rate of 3.3 percent, compared with the nationwide R&D spending growth of 2.5 percent per year.<sup>5</sup> State sources of state R&D spending grew by 3.4 percent annually, from \$0.732 billion (1992 dollars) in 1965 to \$2.010 billion (1992 dollars) in 1995 (table 3). In 1995, state sources for R&D expenditures were equivalent to 1.18 percent of total R&D spending in the Nation, a figure similar to the percentages estimated for 1987 and 1977 (1.20 and 1.21 percent, respectively), and somewhat higher than the 1965 estimate (of 0.90 percent). As a percent of gross domestic product, state sources for R&D have ranged narrowly between 0.025 and 0.032 percent during the 1965-95 period for which there are data.

In terms of the recipients of these state funds, these modified statistics on state agency transfers and direct government budget appropriations indicate that universities historically have received the lion's share of state-funded R&D. In 1995, 80 percent of all state R&D funds from state sources was in support

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<sup>3</sup>These data are available from NSF's annual "Academic Research and Development Expenditures" survey (NSF 1998b). The estimated local government component is a very small part of the combined state and local government funding total. This data substitution approach (summarized in table 3) increases the state totals to universities for the 1965, 1977, and 1987 survey years, but reduces the 1995 state totals. Universities in the academic R&D survey reported \$1.681 billion of nonfederal government R&D support in FY 1995, compared with the \$1.951 billion state academic R&D support that was reported to Battelle/SSTI in their 1995 survey. The causal factors for this reporting divergence are unknown, but may in part reflect timing differences between when funds are appropriated by the state and when universities actually perform the R&D.

<sup>4</sup>State-funded academic R&D expenditures reported in both the NSF academic surveys and Battelle/SSTI state survey comprise only funds directly targeted to academic R&D activities. The state totals do not include undirected general-purpose state government appropriations that are used—at the universities' discretion—for research or to cover the indirect costs for conducting R&D. The reported funding sources for those types of R&D expenditures are the universities themselves, not their state governments. Consequently, the actual contribution of state governments to academic R&D—even with the adjustments made in this report—is understated, particularly for public institutions.

<sup>5</sup>NSF's published national R&D data (NSF 1998a) were adjusted to include the state funding and performance totals reported here.

of university activities, only slightly higher than their estimated 78-percent share in 1965. In terms of the academic R&D performance total, however, universities report that a smaller share of their R&D funding came from state and local government sources in 1995 (7.6 percent of \$22.203 billion spent) than in 1965 (9.7 percent of \$1.474 billion). By 1997, the non-federal government share of the academic R&D total had inched up to 7.7 percent of the \$24.343 billion spent (NSF 1998b).

Not surprisingly, public institutions received considerably more state support than did private institutions<sup>6</sup> and smaller research-performing schools were more dependent on state support than were the larger research-intensive schools. For example, of the top 250 universities in terms of total R&D performance in 1997, 86 received more than the national 7.7-percent average of their R&D funds from state and local governments. South Dakota State, the University of Arkansas, and Kansas State led all others by receiving more than 40 percent of their R&D dollars from such sources. Yet these schools were ranked 199, 114, and 105, respectively, in terms of total R&D performance in 1997. Only two of the 20 universities that reported the highest non-federal government R&D funding shares—University of Florida and Texas A&M—also were ranked among the 20 largest total R&D academic performers (figure 1).

## STATE R&D FOCUS IN 1995

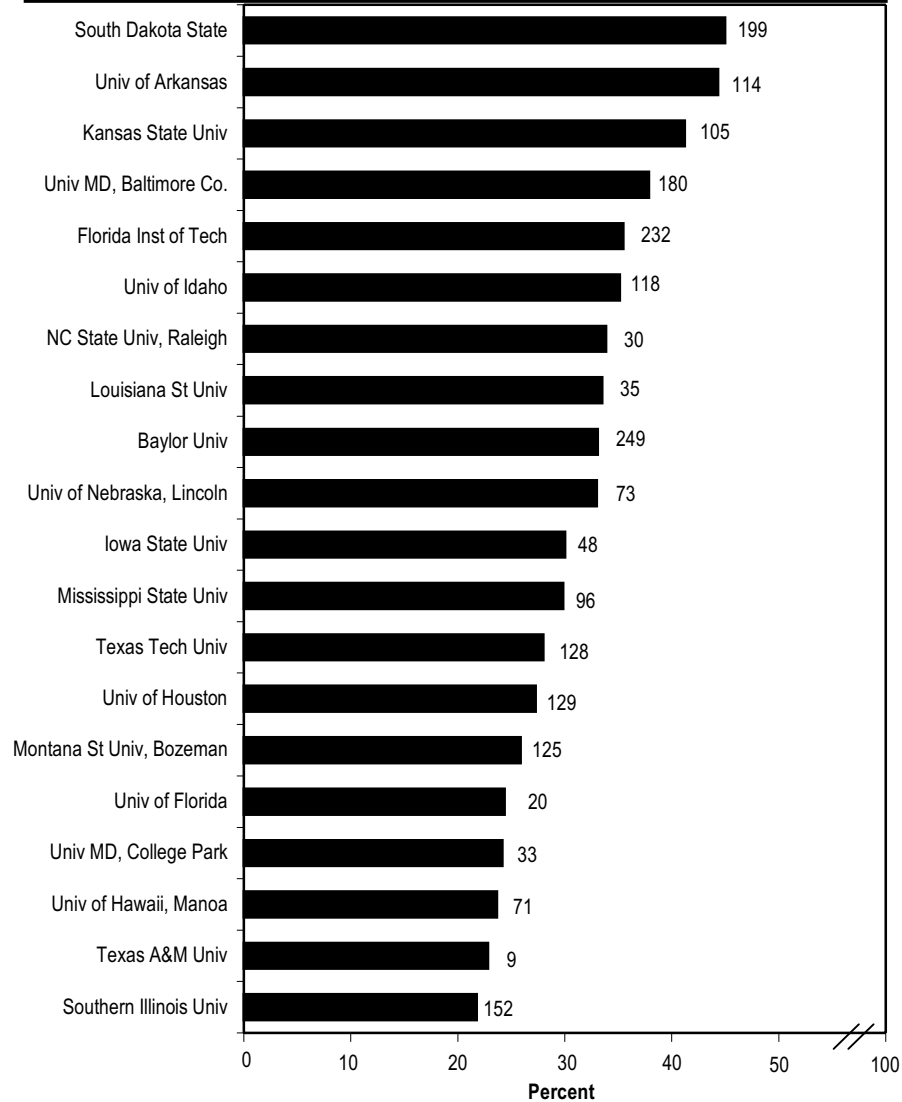
State governments support R&D activities primarily through funding of academic and state agency efforts (table 1). Yet, the research focus differs substantially between these two sets of performers. According to the Battelle/SSTI survey, more than one-half of funds from state sources spent on university R&D performance (\$1.951 billion) in 1995 were in support of the “science and technology base,” which includes research capacity building (figure 2).<sup>7</sup> The only other functional category to receive more than 10 percent of these funds was “food, fiber, other agricultural products,” which accounted for \$0.264 billion of academia’s state-funded R&D performance.

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<sup>6</sup>In FY 1997, public institutions accounted for 67 percent of total academic R&D expenditures in the country (\$16.391 billion of the \$24.348 billion total). Yet these institutions received 91 percent of the \$1.877 billion expended by nonfederal governments in support of university R&D, as reported by universities (NSF 1998b).

<sup>7</sup>The data represent the functional focus of state sources of state spending only, not the total funds provided under state control, which were not collected at this level of disaggregation. For universities, fully 96 percent of the amount provided by state governments (\$2.036 billion) was derived from state sources. Most of the rest derived from Federal sources that were passed through state agencies (table 1).

**Figure 1. Academic institutions where state and local government support accounts for the highest percentage of total R&D support: FY 1997**



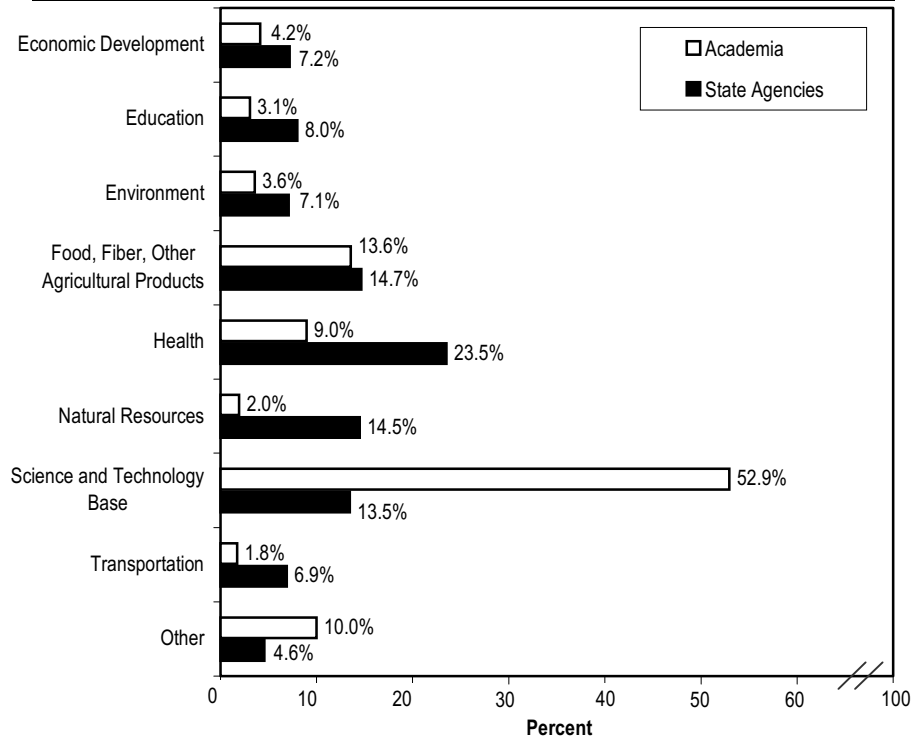
**NOTE:** Numbers after bars are schools' rankings for total 1997 academic R&D performance.

**SOURCE:** National Science Foundation/Division of Science Resources Studies, *Academic Research and Development Expenditures: Fiscal Year 1997* (early release tables). Arlington, VA: 1998.

By comparison, the focus of state-funded R&D performed by state agencies themselves reflect a more diverse mix of functional concerns. “Health” accounted for 24 percent of the \$0.244 billion<sup>8</sup> spent in 1995, followed by “food, fiber, other agricultural products” and “natural resources” (each at 15 percent

<sup>8</sup>For state agencies, state sources provided 60 percent of their total R&D performance funding (\$0.408 billion). The Federal Government was the original source of most of the rest.

**Figure 2. State government R&D expenditures, by performer and function: FY 1995**



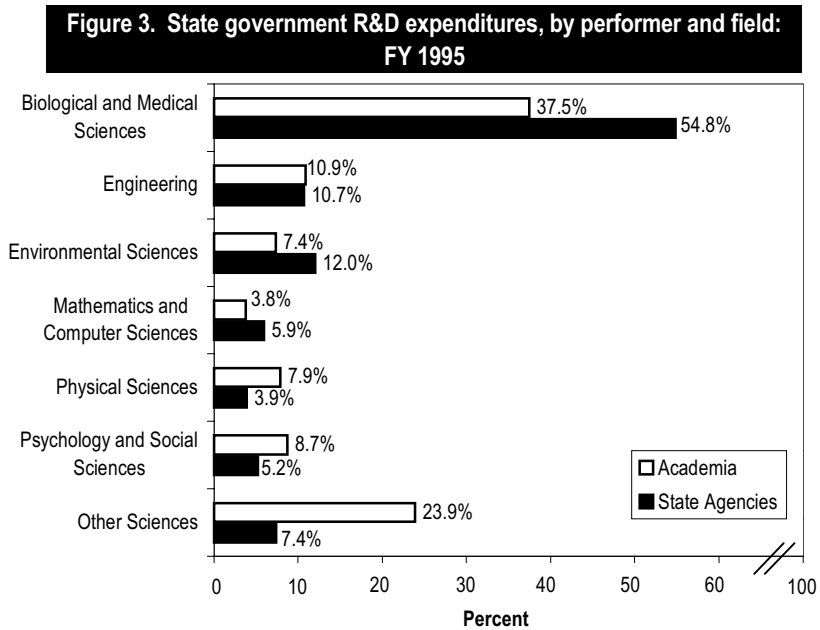
**SOURCES:** National Science Foundation/Division of Science Resources Studies, Battelle Memorial Institute and State Science and Technology Institute. Survey of State Research and Development Expenditures: Fiscal Year 1995. Columbus: September 1998.

of total), and support for the “science and technology base” (14 percent). R&D explicitly related to “economic development” accounted for 7.2 percent (\$0.018 billion) of state agencies’ state-funded R&D performance.

The focus of state funding to other performers also reflects recent trends to use R&D in support of local business and economic growth. “Economic development” accounted for 38 percent of state R&D funds to industry (\$0.033 billion of the \$0.087 billion provided) and 53 percent of state R&D funds to nonprofit organizations (\$0.055 billion of the \$0.105 billion) (not shown in figure 2). By comparison, the functionally equivalent category of “economic growth and productivity” accounted for only 5.0 percent of state funding for R&D to all performers in 1987, and for 2.2 percent of total in 1977. (Since these figures exclude direct appropriations to universities, the historical survey comparisons with the 1995 data are meaningful here.)

In terms of science and engineering fields supported with state R&D funds, the largest shares of university and state agency performance were in the biological and medical sciences, at 37 and 55 percent of the respective per-

former totals (figure 3). Engineering and the environmental sciences each accounted for more than 10 percent of state-funded intramural state agency R&D performance; whereas the remaining field distribution of state-funded university R&D was broadly mixed. As with the functional shares, the field distribution of state-funded industry and nonprofit R&D was highly concentrated: R&D funding for both sectors was predominately in engineering, at 60 and 62 percent of their respective totals (not shown in figure 3).



**SOURCES:** National Science Foundation/Division of Science Resources Studies, Battelle Memorial Institute and State Science and Technology Institute. Survey of State Research and Development Expenditures: Fiscal Year 1995. Columbus: September 1998.

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